Self-Healing Fiber-Reinforced Thermoplastic Composites

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Project Description:

Self-healing composites have been shown to exhibit the extraordinary ability to autonomously detect and repair damage.[1] Although there has been remarkable progress in self-healing polymers and thermoset composites over the past decade,[2] the ability to repair damage in fiber-reinforced thermoplastic composites continues to present technical challenges. Microcapsule-based strategies present an attractive alternative as they are autonomous and can be incorporated into traditional composite systems. This healing scheme (shown in Fig. 1a) involves embedding the material with healing agents sequestered in microscopic containers, which can then heal cracks upon release due to damage. The interstitial areas of neat resin between fiber bundles provide ideal sites to store microcapsules.[3] Microcapsule-based healing targets early onset of damage like microcracks before it progresses to large scale damages like delamination (Fig. 1b). The work proposed here aims to achieve microcapsule-based self-healing in traditional fiber-reinforced thermoplastic composites. As an undergraduate research assistant, your duties will include manufacturing of microcapsule embedded thermoplastic composites. The survival of microcapsules, fiber volume fraction will be characterized using a variety of microscopy techniques (confocal fluorescence, SEM, optical), followed by assessing the healing performance of the modified composites using mechanical testing.

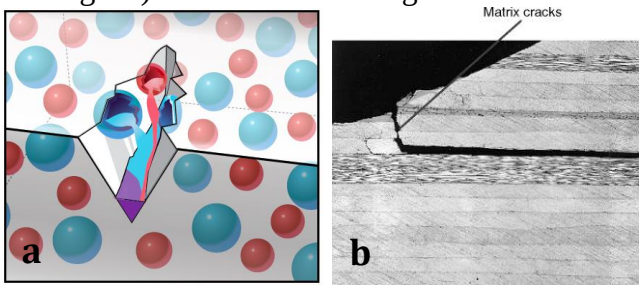

Figure 1. (a) Schematic of capsule-based healing approach. (b) Matrix cracks in a fiber-reinforced polymer composite

Student Background and Expected Research Activities

We are seeking a driven and enthusiastic student who is interested in learning thermoplastic composite manufacturing, various microscopy techniques, thermal analysis techniques and microencapsulation processes. Lab experience and background in polymer science or composites is preferable, but not required. The student should be comfortable handling chemicals and operating mechanical testing equipment.

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References:

(1) Patrick, J. F.; Robb, M. J.; Sottos, N. R.; Moore, J. S.; White, S. R. Nature 2016, 540 (7633), 363.

(2) Blaiszik, B. J.; Kramer, S. L. B.; Olugebefola, S. C.; Moore, J. S.; Sottos, N. R.; White, S. R. 2010, 40 (1), 179–211.

(3) Jones, A. R.; Blaiszik, B. J.; White, S. R.; Sottos, N. R. Compos. Sci. Technol. 2013, 79, 1–7.